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10/799,187	03/12/2004	David L. Detlefs	SMY-111.01	8478

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CHAPIN INTELLECTUAL PROPERTY LAW, LLC  
WESTBOROUGH OFFICE PARK  
1700 WEST PARK DRIVE  
WESTBOROUGH, MA 01581

EXAMINER

LE, MIRANDA

ART UNIT	PAPER NUMBER
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2167

DATE MAILED: 11/14/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

10/799,187

Applicant(s)

DETLEFS, DAVID L.

Examiner

Miranda Le

Art Unit

2167

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 12 March 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-93 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-93 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f):
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB/08)  
Paper No(s)/Mail Date 07/14/04.

- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Information Disclosure Statement*

1. Applicants' Information Disclosure Statement, filed 07/14/2004, has been received, entered into the record, and considered. See attached form PTO-1449.

### *Claim Rejections - 35 USC § 101*

2. 35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

3. Claims 47-93 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

a) Claim 47 recites "A computer system...", however, the claimed system is not limited to embodiments, which include the hardware necessary to enable any underlying functionality to be realized.

Claims 48-69 are dependent upon claim 47, suffer from deficiencies similar to their respective base claim, and therefore are likewise rejected.

b) Claim 70 recites "An electromagnetic signal...", which is directed to a signal per se, i.e., a signal that is not tied to any physical structure for transmitting or receiving the signal and a signal that does not have any specified physical characteristics, signals per se are held to be nonstatutory subject matter. A signal per se, whether an abstract arrangement of information or a physical manifestation of information, does not produce a "useful, concrete and tangible result"

until it is coupled with physical structure. A signal per se is nonstatutory subject matter even if it has a physical existence, because it is not tangible physical matter.

Claims 71-92 are dependent upon claim 70, suffer from deficiencies similar to their respective base claim, and therefore are likewise rejected.

c) Claim 93 is interpreted as invoking 35 USC 112, 6<sup>th</sup> paragraph means plus function, each of the means is reasonably interpreted in view of the specification as just software, the claimed garbage collector is not limited to embodiments which include the hardware necessary to enable any underlying functionality to be realized, instead being software per se.

### ***Double Patenting***

4. A rejection based on double patenting of the "same invention" type finds its support in the language of 35 U.S.C. 101 which states that "whoever invents or discovers any new and useful process ... may obtain a patent therefor ..." (Emphasis added). Thus, the term "same invention," in this context, means an invention drawn to identical subject matter. See *Miller v. Eagle Mfg. Co.*, 151 U.S. 186 (1894); *In re Ockert*, 245 F.2d 467, 114 USPQ 330 (CCPA 1957); and *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970).

A statutory type (35 U.S.C. 101) double patenting rejection can be overcome by canceling or amending the conflicting claims so they are no longer coextensive in scope. The filing of a terminal disclaimer cannot overcome a double patenting rejection based upon 35 U.S.C. 101.

Claims 1-93 provisionally rejected under 35 U.S.C. 101 as claiming the same invention as that of claims 1-93 of copending Application No. 10/986,401. This is a provisional double patenting rejection since the conflicting claims have not in fact been patented.

Claims 1-93 of copending Application No. 10/986,401 contain every element of claims 1-93 of the instant application and thus anticipate the claims of the instant application. Claims of the instant application therefore are not patently distinct from the earlier patent claims and as

such are unpatentable over obvious-type double patenting. A later application claim is not patentably distinct from an earlier claim if the later claim is anticipated by the earlier claim.

***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 1, 2, 9, 11-25, 32, 34-48, 55, 57-71, 78, 80-93 are rejected under 35 U.S.C. 103(a) as being unpatentable over Subramoney et al. (US Pub. No. 20060143421), in view of Coha et al. (US Pub. No. 20030182597).

**As per claim 1**, Subramoney teaches a storage system that contains instruction executable by a computer system to configure the computer system as a garbage collection that reclaims for reuse memory allocated by a mutator executing on the computer system, wherein the garbage collector performs a plurality of successive marking cycles, in each of which the garbage collector:

performs a marking operation in which the garbage collector traces reference chains from a root set and makes associated with respective objects thereby encountered (*i.e. A mark-and-*

*sweep garbage collection program may trace the objects reachable from the roots of the then-operating threads, and may mark the objects that are reachable, [0026]) ([0039]);*

thereafter performs a succession of collection space increments within the marking cycle (i.e. *The events monitored may be identified by the event registers 154, which control the counters 152 to incrementally monitor desired memory performance events, [0031]) ([0028; 0037]);*

terminates that marking cycle and begins the next marking cycle ([0028; 0037]).

Subramoney does not explicitly teach repeatedly calculates a measure of the cumulative efficiency of collection that has taken place during the marking cycle and determines whether the cumulative efficiency thereby calculated satisfies a set of at least one marking-initiation criterion.

However, Coha teaches repeatedly calculates a measure of the cumulative efficiency of collection that has taken place during the marking cycle and determines whether the cumulative efficiency thereby calculated satisfies a set of at least one marking-initiation criterion (i.e. *how efficient this particular garbage collection was, [0026]*).

It would have been obvious to one of ordinary skill of the art having the teaching of Subramoney and Coha at the time the invention was made to modify the system of Subramoney to include the above limitations as taught by Coha. One of ordinary skill in the art would be motivated to make this combination in order to have the memory allocation behavior trace used to configure the *garbage collection* in view of Coha ([0022]), as doing so would give the added benefit of optimizing memory usage for a computer program as taught by Coha ([0011]).

As per claim 24, Subramoney teaches for reclaiming for reuse memory allocated by a mutator executing on the computer system, a method comprising employing the computer system to performs a plurality of successive marking cycles, each of which includes:

A) performing a marking operation by tracing reference chains from a root set and making marks associated with respective objects thereby encountered (*i.e. A mark-and-sweep garbage collection program may trace the objects reachable from the roots of the then-operating threads, and may mark the objects that are reachable, [0026]) ([0039]);*

B) thereafter performing a succession of collection space increments within the marking cycle (*i.e. The events monitored may be identified by the event registers 154, which control the counters 152 to incrementally monitor desired memory performance events, [0031]) ([0028; 0037]);*

D) if so, terminating that marking cycle and beginning the next marking cycle (*[0028; 0037]*).

Subramoney does not explicitly teach repeatedly calculating a measure of the cumulative efficiency of collection that has taken place during the marking cycle and determining whether the cumulative efficiency thereby calculated satisfies a set of at least one marking initiation criterion.

However, Coha teaches repeatedly calculating a measure of the cumulative efficiency of collection that has taken place during the marking cycle and determining whether the cumulative efficiency thereby calculated satisfies a set of at least one marking initiation criterion (*i.e. how efficient this particular garbage collection was, [0026]*).

It would have been obvious to one of ordinary skill of the art having the teaching of Subramoney and Cocha at the time the invention was made to modify the system of Subramoney to include the above limitations as taught by Cocha. One of ordinary skill in the art would be motivated to make this combination in order to have the memory allocation behavior trace used to configure the *garbage collection* in view of Cocha ([0022]), as doing so would give the added benefit of optimizing memory usage for a computer program as taught by Cocha ([0011]).

**As per claim 47**, Subramoney teaches a computer system configured by stored instructions as a garbage collector that reclaims for reuse memory allocated by a mutator executing on the computer system, wherein the garbage collector performs a plurality of successive marking cycles, in each a of which the garbage collector:

A) performing a marking operation by tracing reference chains from a root set and making marks associated with respective objects thereby encountered (*i.e. A mark-and-sweep garbage collection program may trace the objects reachable from the roots of the then-operating threads, and may mark the objects that are reachable, [0026]) ([0039]);*

B) thereafter performing a succession of collection space increments within the marking cycle (*i.e. The events monitored may be identified by the event registers 154, which control the counters 152 to incrementally monitor desired memory performance events, [0031]) ([0028; 0037]);*

D) if so, terminating that marking cycle and beginning the next marking cycle ([0028; 0037]).



Subramoney does not explicitly teach repeatedly calculating a measure of the cumulative efficiency of collection that has taken place during the marking cycle and determining whether the cumulative efficiency thereby calculated satisfies a set of at least one marking initiation criterion.

However, Coha teaches repeatedly calculating a measure of the cumulative efficiency of collection that has taken place during the marking cycle and determining whether the cumulative efficiency thereby calculated satisfies a set of at least one marking initiation criterion (*i.e. how efficient this particular garbage collection was, [0026]*).

It would have been obvious to one of ordinary skill of the art having the teaching of Subramoney and Coha at the time the invention was made to modify the system of Subramoney to include the above limitations as taught by Coha. One of ordinary skill in the art would be motivated to make this combination in order to have the memory allocation behavior trace used to configure the *garbage collection* in view of Coha (*[0022]*), as doing so would give the added benefit of optimizing memory usage for a computer program as taught by Coha (*[0011]*).

**As per claim 70**, Subramoney teaches an electromagnetic signal that represents instructions executable by a computer system to configure the computer system as a garbage collector that reclaims for reuse memory allocated by a mutator executing on the computer system, wherein the garbage a collector performs a plurality of successive marking cycles, in each of which the garbage collector:

A) performing a marking operation by tracing reference chains from a root set and making marks associated with respective objects thereby encountered (*i.e. A mark-and-sweep*

*garbage collection program may trace the objects reachable from the roots of the then-operating threads, and may mark the objects that are reachable, [0026]) ([0039]);*

B) thereafter performing a succession of collection space increments within the marking cycle (*i.e. The events monitored may be identified by the event registers 154, which control the counters 152 to incrementally monitor desired memory performance events, [0031]) ([0028; 0037]);*

D) if so, terminating that marking cycle and beginning the next marking cycle ([0028; 0037]).

Subramoney does not explicitly teach repeatedly calculating a measure of the cumulative efficiency of collection that has taken place during the marking cycle and determining whether the cumulative efficiency thereby calculated satisfies a set of at least one marking initiation criterion.

However, Coha teaches repeatedly calculating a measure of the cumulative efficiency of collection that has taken place during the marking cycle and determining whether the cumulative efficiency thereby calculated satisfies a set of at least one marking initiation criterion (*i.e. how efficient this particular garbage collection was, [0026]*).

It would have been obvious to one of ordinary skill of the art having the teaching of Subramoney and Coha at the time the invention was made to modify the system of Subramoney to include the above limitations as taught by Coha. One of ordinary skill in the art would be motivated to make this combination in order to have the memory allocation behavior trace used to configure the *garbage collection* in view of Coha ([0022]), as doing so would give the added benefit of optimizing memory usage for a computer program as taught by Coha ([0011]).

As per claim 93, Subramoney teaches a garbage collector for reclaiming for reuse memory allocated by a mutator executing on the computer system, the garbage collector including:

A) performing a marking operation by tracing reference chains from a root set and making marks associated with respective objects thereby encountered (*i.e. A mark-and-sweep garbage collection program may trace the objects reachable from the roots of the then-operating threads, and may mark the objects that are reachable, [0026]) ([0039]);*

B) thereafter performing a succession of collection space increments within the marking cycle (*i.e. The events monitored may be identified by the event registers 154, which control the counters 152 to incrementally monitor desired memory performance events, [0031]) ([0028; 0037]);*

D) if so, terminating that marking cycle and beginning the next marking cycle (*[0028; 0037]*).

Subramoney does not explicitly teach repeatedly calculating a measure of the cumulative efficiency of collection that has taken place during the marking cycle and determining whether the cumulative efficiency thereby calculated satisfies a set of at least one marking initiation criterion.

However, Coha teaches repeatedly calculating a measure of the cumulative efficiency of collection that has taken place during the marking cycle and determining whether the cumulative efficiency thereby calculated satisfies a set of at least one marking initiation criterion (*i.e. how efficient this particular garbage collection was, [0026]*).

It would have been obvious to one of ordinary skill of the art having the teaching of Subramoney and Coha at the time the invention was made to modify the system of Subramoney to include the above limitations as taught by Coha. One of ordinary skill in the art would be motivated to make this combination in order to have the memory allocation behavior trace used to configure the *garbage collection* in view of Coha ([0022]), as doing so would give the added benefit of optimizing memory usage for a computer program as taught by Coha ([0011]).

As to claims 2, 11, 16, 18, 20, 23, 25, 34, 39, 41, 43, 46, 48, 57, 62, 64, 66, 69, 71, 80, 85, 87, 89, 92, Coha teaches one said marking-initiation criterion is that the cumulative efficiency has peaked ([0025-0026; 0038; 0067]).

As to claims 9, 32, 55, 78, Subramoney teaches each of a plurality of the collection space increments reclaims a collection set within the heap ([0026-0037]); and

the garbage collector bases the collection set's selection on the marked made by one said marking operation's results ([0026-0037]).

As to claims 12, 14, 19, 35, 37, 42, 58, 60, 65, 81, 83, 88, Subramoney teaches the marking operation occurs at least in part concurrently with the mutator's execution ([0026-0039]).

As to claims 13, 15, 17, 21, 22, 36, 38, 40, 44, 45, 59, 61, 63, 67, 68, 82, 84, 86, 90, 91, Subramoney teaches in each of a plurality of the collection space increments the garbage

collector determines whether objects in an associated collection set within the heap satisfy an unreachability criterion based on the marking operation's results, evacuates potentially reachable objects from the collection set without evacuating any object thus identified, and reclaims the collection set ([0026-0039]).

7. Claims 3, 10, 26, 33, 49, 56, 72, 79 are rejected under 35 U.S.C. 103(a) as being unpatentable over Subramoney et al. (US Pub. No. 20060143421), in view of Coha et al. (US Pub. No. 20030182597), and further in view of Alpern et al. (US Pub No. 6,470,361).

As to claims 3, 26, 49, 72, Subramoney and Coha do not specifically teach one said marking-initiation criterion is that at least a threshold number of collection have occurred during the marking cycle.

However, Alpern teaches marking-initiation criterion is that at least a threshold number of collection have occurred during the marking cycle (*col. 5, line 65 to col. 6, line 26*).

It would have been obvious to one of ordinary skill of the art having the teaching of Subramoney, Coha and Alpern at the time the invention was made to modify the system of Subramoney and Coha to include the limitations as taught by Alpern.

One of ordinary skill in the art would be motivated to make this combination in order to detect when an old object has a pointer to a young object, and needs to be added to the remembered set in view of Alpern, as doing so would give the added benefit of providing the efficient management of remembered sets in a generational garbage collection scheme as taught by Alpern (*col. 5, lines 33-43*).

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As to claims 10, 33, 56, 79, Subramoney and Coho do not expressly teach the garbage collector treats the heap as divided into regions, for which it maintains respective remembered sets that the collection space increments it uses to determine whether objects in the collection set are referred to from outside the collection set and are therefore potentially reachable; and

the garbage collector additionally bases the collection set's selection on the sizes of the remembered sets.

However, Alpern teaches the garbage collector treats the heap as divided into regions, for which it maintains respective remembered sets that the collection space increments it uses to determine whether objects in the collection set are referred to from outside the collection set and are therefore potentially reachable (*col. 2, line 23 to col. 4, line 58*); and

the garbage collector additionally bases the collection set's selection on the sizes of the remembered sets (*col. 2, line 23 to col. 4, line 58*).

It would have been obvious to one of ordinary skill of the art having the teaching of Subramoney, Coho and Alpern at the time the invention was made to modify the system of Subramoney and Coho to include the above limitations as taught by Alpern.

One of ordinary skill in the art would be motivated to make this combination in order to detect when an old object has a pointer to a young object, and needs to be added to the remembered set in view of Alpern, as doing so would give the added benefit of providing the efficient management of remembered sets in a generational garbage collection scheme as taught by Alpern (*col. 5, lines 33-43*).

8. Claims 4-8, 27-31, 50-54, 73-77 are rejected under 35 U.S.C. 103(a) as being unpatentable over Subramoney et al. (US Pub. No. 20060143421), in view of Coha et al. (US Pub. No. 20030182597), and further in view of Patel (US Pub No. 6,349,314).

As to claims 4, 27, 50, 73, Coha teaches an amount of memory reclaimed during that marking cycle and an amount of time taken to by collection during that marking cycle ([0025-0026]).

Subramoney and Coha do not explicitly teach the cumulative collection efficiency for a marking cycle is calculated as the ratio of an amount of memory reclaimed during that marking cycle to an amount of time taken to by collection during that marking cycle.

However, Patel teaches a *ratio* of the total time required to both process the input event and to run the garbage collection process. (*col. 5, line 36 to col. 6, line 30*).

It would have been obvious to one of ordinary skill of the art having the teaching of Subramoney, Coha and Patel at the time the invention was made to modify the system of Subramoney and Coha to include the above limitations as taught by Patel.

One of ordinary skill in the art would be motivated to make this combination in order to calculate the collection urgency index in view of Patel, as doing so would give the added benefit of performing a garbage collection scheduling scheme that lessens the impact of the garbage collection process on the user as taught by Patel (*col. 2, lines 38-41*).

As to claims 5, 28, 51, 74, Coha teaches in determining the amount of memory reclaimed in a cycle, the garbage collector includes the memory reclaimed by all space-incremental-

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collection operations that take place after the end of that marking operation ([0025-0026; 0038; 0067]).

As to claims 6, 29, 52, 75, Subramoney teaches the garbage collector treats the heap as divided into regions ([0007; 0026-0034]); and

the marking operation includes reclaiming regions in which all objects satisfy an unreachability criterion based on that marking operation's results ([0007; 0026-0034]).

As to claims 7, 30, 53, 76, Subramoney teaches in determining the amount of memory reclaimed in a cycle, the garbage collector includes the amount of memory reclaimed as part of the marking cycle's marking operation but omits any memory reclaimed by any space-incremental-collections that take place before the end of that marking operation ([0026-0037]).

As to claims 8, 31, 54, 77, Coha teaches one said marking initiation criterion is that the cumulative efficiency has peaked ([0025-0026; 0038; 0067]).

### ***Conclusion***

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Miranda Le whose telephone number is (571) 272-4112. The examiner can normally be reached on Monday through Friday from 8:30 AM to 5:00 PM.

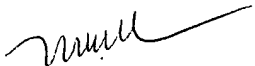
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John R. Cottingham, can be reached on (571) 272-7079. The fax number to this Art Unit is (571)-273-8300.




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Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (703) 305-3900.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Miranda Le  
October 31, 2006



JOHN COTTINGHAM  
SUPERVISORY PATENT EXAMINER  
TECHNOLOGY CENTER 2100